Field Test Program to Develop Comprehensive Design, Operating and Cost Data for Mercury Control Systems on Non-Scrubbed Coal-Fired Boilers

Quarterly Technical Report
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Principal Authors
Richard Schlager
ADA Environmental Solutions, LLC
8100 SouthPark Way, B-2
Littleton, Colorado 80120

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DISCLAIMER

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ABSTRACT

With the Nation's coal-burning utilities facing the possibility of tighter controls on mercury pollutants, the U.S. Department of Energy is funding projects that could offer power plant operators better ways to reduce these emissions at much lower costs.

Mercury is known to have toxic effects on the nervous system of humans and wildlife. Although it exists only in trace amounts in coal, mercury is released when coal burns and can accumulate on land and in water. In water, bacteria transform the metal into methylmercury, the most hazardous form of the metal. Methylmercury can collect in fish and marine mammals in concentrations hundreds of thousands times higher than the levels in surrounding waters.

One of the goals of DOE is to develop technologies by 2005 that will be capable of cutting mercury emissions 50 to 70 percent at well under one-half of today's costs. ADA Environmental Solutions (ADA-ES) is managing a project to test mercury control technologies at full scale at four different power plants from 2000 – 2003. The ADA-ES project is focused on those power plants that are not equipped with wet flue gas desulfurization systems.

ADA-ES will develop a portable system that will be moved to four different utility power plants for field testing. Each of the plants is equipped with either electrostatic precipitators or fabric filters to remove solid particles from the plant's flue gas.

ADA-ES's technology will inject a dry sorbent, such as fly ash or activated carbon, that removes the mercury and makes it more susceptible to capture by the particulate control devices. A fine water mist may be sprayed into the flue gas to cool its temperature to the range where the dry sorbent is most effective.

PG&E National Energy Group is providing two test sites that fire bituminous coals and both are equipped with electrostatic precipitators and carbon/ash separation systems. Wisconsin Electric Power Company is providing a third test site that burns Powder River Basin (PRB) coal and has an electrostatic precipitator for particulate control. Alabama Power Company will host a fourth test at its Plant Gaston, which is equipped with a hot-side electrostatic precipitator and a downstream fabric filter.

During the sixth reporting quarter, progress was made on the project in the following areas:

PG&E NEG Brayton Point Station

- Laboratory screening testing of a number of candidate sorbents were completed by URS.
- Sorbent screening testing was performed on site at the station in February.
- The test plan for the field testing phase of the project was prepared and being reviewed.
- A meeting was held at Brayton Point during the quarter with construction contractors. Equipment installation is scheduled for April.

Wisconsin Electric Pleasant Prairie Power Plant

- Analysis of data from the full-scale tests was conducted.

- Ash and coal samples were analyzed by MicroBeam Technologies and Wisconsin Electric.
- A paper summarizing the full-scale tests was written and submitted to A&WMA for presentation at the annual meeting in June 2002.

Technology Transfer

- A number of technical presentations and briefings were made during the quarter. Notable is testimony related to the program that was provided to a Senate Subcommittee.

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There are no graphical materials included in this report.

EXECUTIVE SUMMARY

ADA-ES began work on a Cooperative Agreement with the Department of Energy in October, 2000 to demonstrate full-scale mercury control systems at coal-fired power plants. The project is the next step in the process of obtaining performance and cost data on full-scale utility plants for mercury control systems. Power generating companies that have entered into contracts with ADA-ES are PG&E National Energy Group, Wisconsin Electric Power Company and Alabama Power Company. During the three-year, $6.8 million project, integrated control systems will be installed and tested at four power plants. ADA-ES is responsible for managing the project including engineering, testing, economic analysis, and information dissemination functions.

As of the sixth reporting quarter, progress on the project has been made in the following areas:

- Alabama Power Company Plant Gaston – field testing has been completed.
- Wisconsin Electric Pleasant Prairie Power Plant – field testing has been completed.
- PG&E NEG Brayton Point Station – sorbent screening testing has been completed. Preparations for installing equipment are underway.

Several technical papers were presented on the project during the sixth reporting quarter including a project briefing to the Wisconsin Department of Natural Resources and testimony to the Senate Committee on Environment and Public Works, Subcommittee on Clean Air, Wetlands, and Climate Change.

INTRODUCTION

Cooperative Agreement No. DE-FC26-00NT41005 was awarded to ADA-ES to demonstrate mercury control technologies on non-scrubbed coal-fired boilers. Under the contract, ADA-ES will work in partnership with PG&E National Energy Group, Wisconsin Electric Power Company, Alabama Power, and EPRI to design and engineer systems to maximize effectiveness and minimize costs to curtail mercury emissions from power plant flue gases. Reports estimate that mercury control could cost the industry from $2 to $5 billion per year. Much of these costs will be associated with power plants that do not have wet scrubbers as part of their air pollution control configurations. The four plants that will be evaluated during the ADA-ES program are typical of this type of application which is found at 75% of the nearly 1100 units that would be impacted by new regulations.

Detailed topical reports will be prepared for each site that is tested under the program. Quarterly reports will be used to provide project overviews and technology transfer information.

EXPERIMENTAL

Field work was conducted on the project during the sixth reporting quarter at PG&E's Brayton Point Station in the form of sorbent screening testing. In addition, meetings were held at the site to plan equipment installation which is scheduled to begin in April 2002. Detailed results of the testing at each power plant will be provided in separate topical reports.

Technology Transfer

Technology transfer activities continued during the sixth reporting quarter of the project. Reference citations of the formal presentations are provided below:

Senior, C., C.J. Bustard, M. Durham and K. Baldrey (2002). "Characterization of Fly Ash from Full-Scale Testing of Sorbent Injection for Mercury Control on Coal-Fired Power Plants," presented at Hg Control – The Effects on By-Products: What Do We Know and Where Do We Go?, U.S. DOE, Pittsburgh, PA, March 19.

Durham, M.D. (2002). "Full-Scale Demonstration of Mercury Control on Boilers Burning Bituminous and Subbituminous Coals," presented at Mercury – Consequences for Environment and Health, A&WMA, Montreal, Quebec, March 4-6.

Presentation of Project Information made to the Wisconsin Department of Natural Resources and the Public Service Commission of Wisconsin, February 25, 2002.

U.S. Department of Energy (2002). "Advanced Mercury Control System's Performance is on Track, Test Shows," Fossil Energy TechLine, February 18.

Testimony on Compliance Options for Electric Power Generators to Meet New Limits on Carbon and Mercury Emissions, testimony given by Michael D. Durham to the Senate Committee on Environment and Public Works, Subcommittee on Clean Air, Wetlands, and Climate Change, Washington, D.C., January 29, 2002.

Durham, M.D. (2002). "Status and Future Development of Mercury Removal Technologies," presented at the Building New Coal-Fired Generation Conference, Infocast, Phoenix, AZ, January 23-25.

Bustard, C.J. (2002). "Full-Scale Evaluation of the Injection of Activated Carbon for Mercury Control for Eastern and Western Coals," presented at the Fifth Electric Utilities Environmental Conference, organized by EPA-DOE-EEI-EPRI-ETIC, Tucson, AZ, January 23.

Durham, M.D. (2002). "Results – Full Scale Evaluation of Mercury Control with Sorbent Injection and COHPAC on the Alabama Power E.C. Gaston Station," presented at the FOMIS Mercury Emissions Workshop "Maximum Achievable Control Technology…an O&M Perspective", Clearwater Beach, FL, January 21-22.

Durham, M.D. (2002). "Results – Full Scale Evaluation of Mercury Control with Sorbent Injection on a Unit Burning PRB Coal with an ESP at the Wisconsin Electric Power Pleasant Prairie Power Plant," presented at the FOMIS Mercury Emissions Workshop "Maximum Achievable Control Technology…an O&M Perspective", Clearwater Beach, FL, January 21-22.

Coughlin, T. (2002). "Operations, Maintenance and Monitoring Impact of Mercury Control with Sorbent Injection on a Unit Burning PRB Coal with an ESP at the Wisconsin Electric Power Pleasant Prairie Power Plant," presented at the FOMIS Mercury Emissions Workshop

"Maximum Achievable Control Technology…an O&M Perspective", Clearwater Beach, FL, January 21-22.

Monroe, L. (2002). "Operations, Maintenance and Monitoring Impact of Mercury Control with Sorbent Injection and COHPAC on the Alabama Power E.C. Gaston Station," presented at the FOMIS Mercury Emissions Workshop "Maximum Achievable Control Technology…an O&M Perspective", Clearwater Beach, FL, January 21-22.

Bustard, C.J., M. Durham, C. Lindsey, T. Starns, K. Baldrey, C. Martin, R. Schlager, S. Sjostrom, R. Slye, S. Renninger, L. Monroe, R. Miller and R. Chang (2002). "Full-Scale Evaluation of Mercury Control with Sorbent Injection and COHPAC at Alabama Power E.C. Gaston," presented at the FOMIS Mercury Emissions Workshop "Maximum Achievable Control Technology…an O&M Perspective", Clearwater Beach, FL, January 21-22.

Newspaper Articles and Press Releases during the Quarter

Arch Coal Inc. Joins ADA-ES Mercury Emissions Control Effort, Energy Secretary Abraham Lauds Participation by Arch Coal, Press release, March 20, 2002.

"Littleton company succeeds in cleaning coal plant emissions," The Denver Post, page 1C, January 22, 2002.

"WE-WG Completes Testing of Mercury Controls; Pleasant Prairie Power Plant, Tests Yield Promising Results," press release issued by Wisconsin Electric-Wisconsin Gas and ADA-ES, January 21, 2002.

RESULTS AND DISCUSSION

The major efforts during the sixth reporting quarter focused on beginning the sorbent screening testing process at Brayton Point, working with Brayton Point site and contractor personnel for the installation of the sorbent injection equipment, and continued analyses and documentation of data and results from the Pleasant Prairie test. Detailed results of the testing at each power plant will be provided in separate topical reports.

CONCLUSION

Work began on Cooperative Agreement No. DE-FC26-00NT41005 in October 2000. Initial activities include holding a project kickoff meeting, securing the fourth test site (Alabama Power Company Plant Gaston), and performing various planning and administrative functions. Field testing began during the second reporting period at Plant Gaston, and test planning for the remaining sites began. Test work was completed at the Gaston site during the third reporting period. Site preparations were completed and field testing began at Wisconsin Electric during the fourth reporting period and all site work was completed during the fifth reporting quarter. Sorbent screening activities were completed at Brayton Point during the sixth reporting quarter. Technology transfer activities during the quarter and commitments for presenting project information at future meetings have been made. Arch Coal joined the project team during the quarter.

REFERENCES

None this reporting period.

LIST OF ACRONYMS AND ABBREVIATIONS

A&WMA	Air & Waste Management Association
DOE	Department of Energy
PRB	Powder River Basin
WEPCO	Wisconsin Electric Power Co.

ATTACHMENT A

Accomplishments and Status Assessment
January 1, 2002 – March 31, 2002

- **General**
  An agreement was signed with Arch Coal Company during the quarter to participate in the PG&E NEG portions of the project.

  The project is progressing on schedule without any major deviations from plan.

- **Alabama Power Company's Plant Gaston**
  This facility was the first to be tested in the program. Prebaseline testing was completed in February, 2001 and the parametric test series was performed in March, 2001. The long-term test series was completed during April, 2001. The test facility was decommissioned during May. Economic analysis and topical report were started in June and are continuing. Ontario Hydro test results have been completed. Several questions on coal and ash analysis remain to be resolved.

- **WEPCO Pleasant Prairie Power Plant**
  Sorbent screening testing was completed at Pleasant Prairie in June, 2001. Equipment installations were completed in August, 2001. WEPCO hosted a public site tour of the mercury control system at the end of August as part of the A&WMA Specialty Conference on Mercury Emissions. Equipment check-out was completed in September and Baseline and Parametric testing began during September 2001. Long-term testing was completed in November, and the mercury control equipment was removed during December and moved to PG&E NEG Brayton Point.

- **PG&E NEG Salem Harbor Station**
  Prebaseline measurements were made at Salem Harbor during February 2001. Mercury emissions measurements were made at the station during July 2001 as required by the state of Massachusetts. Additional prebaseline testing, parametric and long-term testing of Salem Harbor is scheduled for Fall, 2002. Ash samples are being analyzed by Microbeam Technologies and results are being evaluated.

- **PG&E NEG Brayton Point Station**
  Prebaseline testing was performed at Brayton Point during June 2001. Mercury emissions measurements were made at the station during the summer of 2001 as required by the state of Massachusetts. The site was visited in July 2001 to evaluate the ductwork, port locations, equipment locations and platform needs. Some site preparation work was done during September 2001. The mercury control equipment was received by the station in December 2001. Sorbent screening testing was performed at the site in February 2002, and preparations were being made to install the sorbent injection equipment.

- **Technology Transfer**
  A number of technology transfer activities have taken place since the project began in October 2000. More activities are planned for future conferences, symposia and technical publications. Presentations were made during the quarter at a NETL Fly Ash conference, an A&WMA conference, the Wisconsin Department of Natural Resources and the Public Service Commission of Wisconsin, the FOMIS Mercury Emissions Workshop, and at the

Fifth Electric Utilities Environmental Conference. Dr. Michael Durham, ADA-ES manager of the program presented testimony on the project to the Senate Committee on Environment and Public Works, Subcommittee on Clean Air, Wetlands, and Climate Change.

ATTACHMENT B

Technical Papers, Press Releases and Other Published Information

TESTIMONY BEFORE THE
U.S. SENATE COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS

On

Status of Sorbent Injection Mercury Control Technology
Dirksen Senate Office Building

Presented by
Michael D. Durham, Ph.D., MBA
ADA Environmental Solutions
8100 SouthPark Way, B-2
Littleton, CO 80120
(303) 734-1727
www.adaes.com

January 29, 2002

Solutions (ADA-ES). ADA-ES is a company that develops and commercializes novel air pollution control technology for the power industry. We are currently managing a $6.8 million program involving a team of the-nations leading engineers and scientists to scale-up and demonstrate sorbent-based mercury control technology. The Department of Energy National Energy Technology Laboratory (NETL) is providing two thirds of the funding for the program. The remaining funds are provided by co-funding team members including: PG&E National Energy Group, Southern Company, Wisconsin Electric-Wisconsin Gas (WE-WG), EPRI, Ontario Power Generation, FirstEnergy, TVA, and Kennecott Energy Company as well as ADA-ES and other equipment suppliers.

During 2001 we successfully completed two short-term programs that represent the first full-scale demonstrations of sorbent-based mercury control technology in the US power industry. Tests were conducted on both bituminous and subbituminous coals. I have submitted detailed documents describing our program and am presenting results from these two demonstrations. These results provide us with an early indication of both the high potential and limitations of this technology. This morning I will briefly summary results and discuss plans for the continued development of this technology.

I. Summary

Sorbent injection technology represents one of the simplest and most mature approaches to controlling mercury emissions from coal-fired boilers. It involves injecting a solid material such as powdered activated carbon (PAC) into the flue gas. The gas phase mercury in the flue gas contacts the sorbent and attaches to its surface. The sorbent with the mercury attached is then collected by the existing particle control device along with the other solid material, primarily fly ash. This combined material is then either disposed of or beneficially used in building materials.

Two demonstrations were conducted during 2001. The first program was completed in the spring at the Alabama Power E.C. Gaston Station. This unit burns a low-sulfur bituminous coal and uses a COHPAC baghouse to collect the carbon and flyash. The second program was conducted during the fall at the WE-WG Pleasant Prairie Power Plant. This unit burns a subbituminous Powder River Basin (PRB) coal and uses an electrostatic precipitator (ESP) to collect the carbon and flyash.

These programs demonstrated that it is possible to design, build, and operate equipment at a scale capable of treating power plant flue gas. To date, the injection equipment has operated successfully at both sites. The results from the short-term (8 hour) parametric tests from both programs are plotted in Figure 1. We are encouraged by the potential shown by the PAC technology during these two successful demonstrations in that short-term removal levels in excess of 90% were achieved in the case where COHPAC was used. These tests also proved that activated carbon was effective on both forms of mercury, elemental and oxidized. Elemental mercury has been proven to be the most difficult form of mercury to capture. It is the dominant species in PRB coal (83% at Pleasant Prairie) but it is also found in bituminous coals (40% at Gaston).

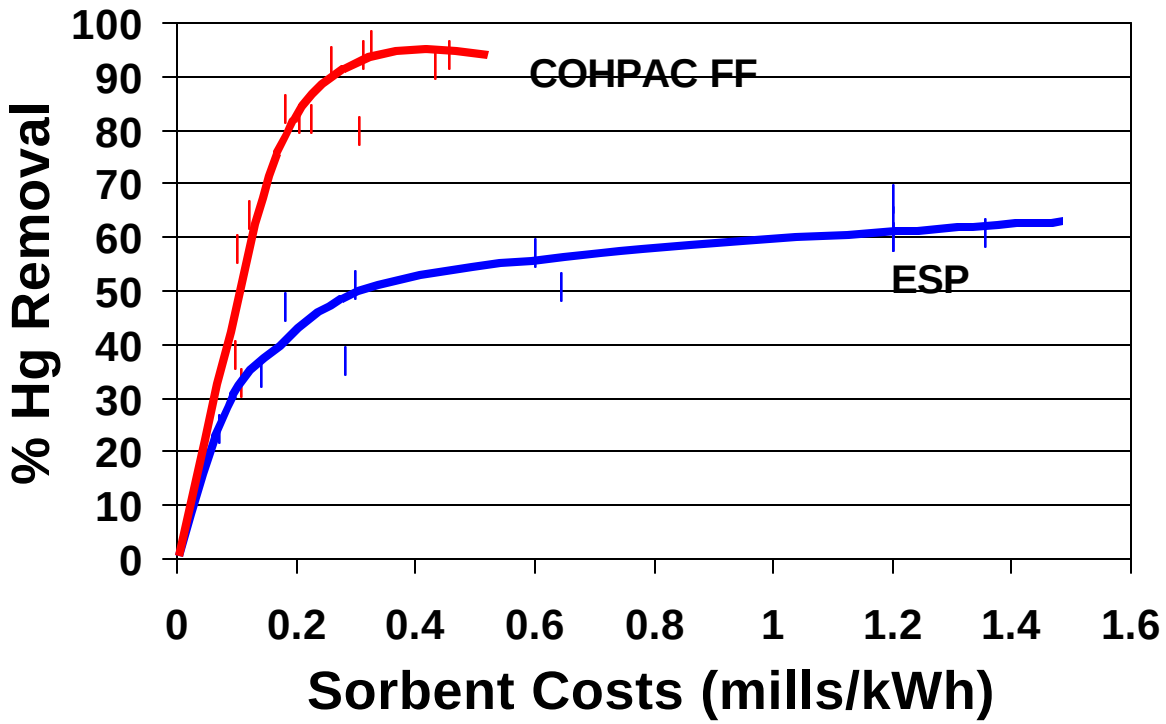

Figure 1. Results of Parametric Tests of Mercury Control by Injecting Powdered Activated Carbon at Two Power Plants

However, these results also documented several limitations of the technology. From the data in Figure 1 it is obvious that the downstream particle control is the dominating factor in determining removal efficiency. While removal levels of 90% were obtained with the fabric

filter (baghouse), even with spray cooling the ESP collecting PRB ash was limited to levels of 50-70%. Since only 10% of the plants have baghouses, capital expenditures of $40-50/kW would be required to achieve the higher levels. Operating data obtained at Gaston also showed that PAC injection produced increased pressure drop in the baghouse. This will require that COHPAC baghouses designed for use with PAC will have to be larger to accommodate the increased mass. At Pleasant Prairie, it was discovered that the presence of activated carbon in the ash prevented WE-WG from selling the ash for use in concrete. This represents a significant cost that must be incorporated into the economics of the technology.

It must also be noted that these tests only ran for very short periods of time with the longest continuous runs being two weeks. During the test program, the plants accommodated the needs of the R&D program by operating at full load conditions. This produces more of a steady state condition than is found during their typical load cycling operations. Even with constant load conditions, with variations in coal characteristics, it was not possible to maintain the 90% removal levels over a five-day continuous run, with the average dropping to 80-85%.

II. Background on Sorbent Injection

Sorbent injection technology involves the injection of a dry sorbent, such as activated carbon powder, into the flue gas duct somewhere between the air preheater and the ESP or fabric filter (FF), as shown in Figure 2. This is typically in the 250-350 degree F range. Vapor-phase mercury is adsorbed onto the activated carbon, which is then collected in the ESP or FF. The mercury-activated carbon interaction continues to occur in the ESP or FF. The technology can be used in conjunction with flue gas temperature control, usually accomplished through the injection of water (spay cooling) droplets into the flue gas.

A variation of the configuration shown in Figure 2 using a high air-to-cloth Pulse-Jet Baghouse installed downstream of the existing ESP was developed and patented by EPRI. This configuration, without carbon injection, is called COHPAC. When a sorbent is injected into the baghouse for pollutant control, the process is called TOXECON. This approach focuses on improving the efficiency of sorbent injection by providing high efficiency particulate collection as well as a good "contact" scheme for the sorbent and mercury (e.g. the FF). This technology also minimizes the amount of the fly ash that can be contaminated by the mercury sorbent.

The most commonly studied sorbent for mercury control has been activated carbon. This material has been successfully used as a sorbent in municipal and hazardous waste combustors. Activated carbon is carbon that has been “treated” to produce certain properties such as surface area, pore volume, pore size. Activated carbon can be manufactured from a variety of sources, (e.g. lignite, peat, coal, wood, etc.). More commonly, steam is used for activation, which requires carbonization at high temperatures in an oxygen-lean environment. As some carbon atoms are vaporized, the desired highly porous activated carbon is produced. Commercially, activated carbons are available in a range of particle sizes, as well as other characteristics that are needed for a specific application.

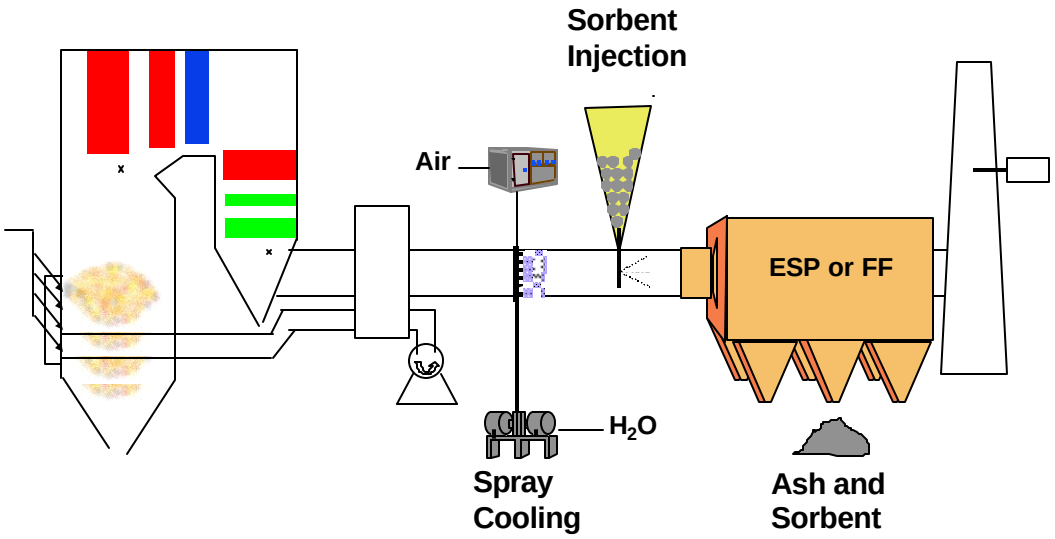

Figure 2. Schematic Diagram of Sorbent Injection Process

Laboratory, pilot scale and modeling programs have indicated that the following parameters can affect the ultimate performance of the technology:

- Particulate control device: ESP vs. fabric filter,
- sorbent type and properties,
- gas-phase mercury species (Hg^o or $HgCl_2$),
- temperature,
- concentration of acid gases (HCl, SO_2, NO, NO_2) in the flue gas, and
- residence time.

The type of particulate control equipment is a key parameter defining both the amount of sorbent that is required and provides the ultimate limitation of the amount of mercury that can be removed. When the sorbent is injected into the flue gas it mixes with the gas and flows downstream. This provides an opportunity for the mercury in the gas to contact the sorbent where it is removed. This is call "in flight" capture. The sorbent is then collected in the particulate control device where there is a second opportunity for sorbent to contact the mercury in the gas.

In an ESP, the carbon is collected on plates that are spaced parallel to the gas flow. Although the residence time in the ESP can be several seconds long, there is a limited amount of contact between the gas and the collected particles because the gas can be as far as four inches from the

plates. On the other hand, the fabric filter provides the ideal opportunity for good interaction between the gas and the sorbent as the gas makes intimate contact with the sorbent collected on the filter. Therefore, sites with fabric filters will achieve higher levels of mercury removal and higher levels of sorbent utilization. Unfortunately, only 10% of the coal-fired power plants in the US have fabric filters.

III. Conclusions and Future Plans

The injection of powdered activated carbon offers a promising approach for mercury control for coal-fired boilers. The injection equipment is relatively inexpensive ($2/kW) and can be installed with minimal downtime of the plant. It is effective for both bituminous and subbituminous coals and when interfaced with a fabric filter it is capable of high levels of mercury removal. It is versatile in that it could also be integrated with a wet scrubber to remove elemental mercury that escapes the scrubber.

However, a great deal of additional testing is required to further characterize the capabilities and limitations of this technology. It is important to determine performance on a wider variety of fuels and plant operating configurations. Long-term testing will be necessary to discover if there are any negative impacts of the PAC on downstream components. Impacts such as deposition, fouling of the ESP, corrosion, and shortened bag life often take months to years to be observed or measured.

As with all other air pollution control technologies, sorbent-based mercury control is a developing technology that needs to go through a phased approach as it matures to become accepted as commercially viable. This approach to implementation of new technology has evolved from thirty years of lessons learned by the power industry from applying new technology.

The schedules announced by EPA and Federal and State legislatures to require widespread implementation of mercury control for the coal-fired boiler industry by 2007 represents an extremely challenging schedule. To advance the sorbent injection technology to meet this tight timeframe, we plan to participate in partnerships with DOE and power companies in risk-shared programs such as the Clean Coal Power Initiative (CCPI). The following schedule will allow us accomplish this in a controlled manner that doesn't put generation capacity at risk:

- Short-term full-scale evaluations (2000-2003)
    - Parametric evaluations
    - Multiple sites to evaluate different configurations and fuels
- Long-term full-scale demonstrations (2003-2005)
- First commercial installations at a few early adopters (2005-2007)

In addition, there are two other areas where advancements must be made to assure the ultimate success of this technology. In order to respond to changes in fuel and operating conditions, it is critical to have a reliable continuous measurement of the mercury in the flue gas. This is

important from both a process control and a compliance monitoring perspective. The other area involves increasing the production of activated carbon to a level sufficient to supply the power industry. Current capacity of US suppliers is only 10% of what may be required for widespread implementation of the technology.

Fossil Energy Techline

February 18, 2002

Advanced Mercury Control System's Performance is on Track, Test Shows

Kenosha, WI - Preliminary results of a Department of Energy-sponsored mercury-control technology show the technology is living up to its design potential.

More mercury from coal plants burning subbituminous coal and using an electrostatic precipitator (ESP) to collect fine particles and fly ash can be removed with a carbon-sorbent-injection system even when less carbon is used. This finding is significant because subbituminous coal, especially that of the Powder River Basin in Wyoming, typically generates a high amount of elemental mercury. A large-scale demonstration conducted by ADA Elemental Solutions of Littleton, Colo. indicates that injecting a dry carbon sorbent into the gas stream may provide an effective solution for those PRB plants equipped with ESP's for particulate control.

The market is certainly sizable. Approximately 90 percent of all coal plants in the United States use ESPs, notes Mike Durham, president of ADA-ES.

Carbon injection is the simplest and most mature mercury-control technology being field tested (today)," he said. With the Environmental Protection Agency developing regulations that could require large mercury reductions at the nation's 1,100-plus coal units by 2007, a viable, economic technology would play a very promising role in future power generation.

After two weeks of testing a carbon sorbent for mercury control at a coal plant operated by Wisconsin Electric-Wisconsin Gas (WE-WG) near Kenosha, Wis., ADA-ES reported that mercury-removal rates range from 40 to 70 percent while carbon-injection rates vary from 2-10 lbs/hr of carbon injected for every 1 million cubic feet of gas that was treated. Previous modeling indicated that carbon injected upstream of an ESP would require injection rates exceeding 30 lbs/hr to remove 50% of mercury.

Although this level of mercury removal is certainly encouraging, other issues, such as an increased carbon content in the fly ash, may cause significant economic losses to a plant that sells 100 percent of its flyash for concrete applications. Even at the lowest activated carbon-injection rates, the carbon content in flyash was too great for buyers to accept. One possible solution is to install a fabric filter downstream of the ESP. This way, the carbon would be injected after the ESP and collected by the fabric filter.

Because mercury adheres to activated carbon or fly ash that is injected into a plant's gas stream, ESPs or fabric filters capture more of the pollutant. In ADA's technology, a fine water mist may also be sprayed into the flue gas to cool its temperature (if it exceeds about 300^{o} F) to the range where the dry sorbent is more effective.

DOE selected ADA-ES to perform large-scale sorbent-injection for mercury removal at four different coal plants in the United States in the fall of 2000. The first test site was Alabama Power's Gaston plant, Wilsonville, Ala., which fires low-sulfur Eastern bituminous coal and uses fabric filters to reduce particulate matter emissions. Fabric filters are capable of removing at least 80 percent of mercury by injecting 1/10th the amount of carbon needed for an ESP. Results from the Gaston site indicate that as much as 90 percent of all mercury was removed at the highest performing periods during two weeks of testing. WE-WG was the second site to be tested.

Two species of mercury, elemental and oxidized, are produced from coal-fired power plants. The oxidized form of mercury can be removed by a conventional wet scrubber if it is part of a plant's configuration. If not, then a carbon-injection system such as ADA's is required to remove both species. Because contact

between the gas and carbon is not as good in plants using ESPs rather than fabric filters, mercury removal rates aren't as high.

Nonetheless, the WE-WG results are encouraging because mercury emissions from low-sulfur Western coals is one of the most difficult to control, and the plant is representative of a number of large power stations across the country.

A next step in sorbent-injection development and commercialization, Durham said, could be to test the system on different coals for longer periods of time and to use it in concert with a scrubber. Past tests have been significantly smaller (1-megawatt pilot tests). Competing methods such as non-carbon-based sorbents or oxidation catalysts have not been field tested at this scale and, as a result, could lag a few years behind in the development cycle, Durham estimates.

Because mercury control is now being discussed in several bills before Congress, it is taking on greater importance as time goes by, said Durham, who added that Massachusetts, New Hampshire and Wisconsin have all announced plans to regulate mercury in the next few years, and several utilities have vowed to install mercury controls by 2006.

ADA will also test its injection system at two PG&E Generating's plants, both of which fire low-sulfur bituminous coals and are equipped with ESPs and carbon/ash separation systems. The technology will be demonstrated at the Brayton Point power station, Somerset, Mass. this spring and Salem Harbor, Salem, Mass. in the fall.

The project is receiving $4.5 million from the Energy Department. ADA-ES and an 11-organization support team is providing an additional $2.2 million.

-End of *TechLine* -

Technical contact:
Scott A. Renninger, DOE National Energy Technology Laboratory,
304/285-4790, e-mail: scott.renninger@netl.doe.gov

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WE-WG Completes Testing of Mercury Controls; Pleasant Prairie Power Plant Tests Yield Promising Results

1/21/2002

MILWAUKEE, Jan. 21 /PRNewswire-FirstCall/ -- Wisconsin Electric-Wisconsin Gas (WE-WG) and ADA Environmental Solutions (ADA-ES) are releasing preliminary findings from one of the nation's first full-scale tests of carbon injection to control power plant mercury emissions. The findings are being presented Jan. 21 at the FOMIS Mercury Emissions Workshop in Florida and Jan. 23 at the Electric Utilities Environmental Conference in Arizona. The testing was conducted at WE-WG's Pleasant Prairie Power Plant (P4) near Kenosha, Wis.

At this time, the research team can conclude the following from the preliminary results:

-- It is possible to design, build and operate equipment at a scale capable of treating very large power plant flue gas volumes. -- Mercury removal rates during the short-term tests at P4 ranged from 40 to 60 percent depending on the amount of sorbent injected. -- Continuous injection over a two week period showed that the upper limit for mercury removal at P4 appears to be between 60 and 70 percent. However, beyond 50 percent removal, the mercury reduction benefit of increased sorbent injection begins to rapidly decrease. -- Plant operators did not note adverse impacts on electrostatic precipitator (ESP) performance attributable to sorbent injection during the test period. -- Preliminary test results indicate that the injection of even small amounts of activated carbon will prevent P4's fly ash from being beneficially re-used in concrete and will result in landfilling the fly ash. -- Injection rates required to get 50 to 60 percent removal were significantly lower than expected. -- Spray cooling, by water injection to lower flue gas temperature, did not improve mercury removal at P4.

Long-term testing is needed to fully assess the cost and performance of the technology as well as its impacts on the operation of the entire generating plant.

"We're encouraged by the results," said Kristine Krause, vice president of Environmental for Wisconsin Energy Corp. (NYSE: WEC). "We look forward to completing the remaining phases of this program and assessing the impacts of the technology on our overall operations. The P4 mercury research is an essential part of the company's integrated plan for reducing emissions and improving air quality."

"This mercury control test is a significant step in demonstrating that activated carbon injection can effectively reduce elemental mercury, the most difficult form to capture, which is produced from western coals," said Dr. Michael Durham, president of ADA-ES. "But we must learn more about how this technology works over time and with other coals and other plant configurations."

Sorbent injection is the most mature of all mercury specific control technologies. Pilot scale testing under actual flue gas conditions, but at reduced scale, was conducted at P4 in June of 2000. The full-scale demonstration, where sorbents were injected into one-fourth of a 600 MW unit under normal operating conditions, was conducted in the fall of 2001. The full-scale test provided information about the capabilities and limits of this developing technology.

The tests at P4 are very important because the plant burns a low-sulfur, western coal. The EPA acknowledged in its decision to develop regulations for reducing mercury emissions from utility coal-fueled boilers that mercury emissions from utilities that burn low sulfur, western coals -- like WE-WG -- will be most difficult to control.

The P4 research is also important because the plant configuration is representative of a large number of power plants across the country. P4 has an ESP in place to capture and collect ash particles. Ninety percent of all the coal-fueled power plants in the United States control particulate emissions with ESPs

and test results will provide needed information on the potential use of this mercury-specific technology at other power plants. The type of particulate control equipment is a key parameter defining both the amount of sorbent that is required and the ultimate limitation of the amount of mercury that can be removed using sorbent injection methods.

Final results on the P4 research will be available later this year.

The project was done in collaboration with the U.S. Department of Energy's National Energy Technology Laboratory (NETL) and the Electric Power Research Institute (EPRI). The majority of the $6.8 million program's cost is being picked up by NETL. About a third of the costs are being covered by WE-WG, EPRI, ADA-ES, Alabama Power, PG&E National Energy Group, Ontario Power Generation, First Energy, TVA, Kennecott Coal, and EPA.

Wisconsin Electric-Wisconsin Gas, the principal utility subsidiary of Wisconsin Energy Corp., serves more than one million electric customers and more than 960,000 natural gas customers throughout Wisconsin and Michigan's Upper Peninsula. Visit the company's Web site at http://www.WE-WG.com . Learn about Wisconsin Energy Corp. by visiting http//www.WisconsinEnergy.com

ADA-Environmental Solutions, LLC (ADA-ES) is an environmental technology and specialty chemical company headquartered in Littleton, Colo. The company brings 25 years of experience to improve profitability for electric power and industrial companies through proprietary products and systems that mitigate environmental impact while reducing operating costs. ADA-ES is a subsidiary of Earth Sciences (OTC Bulletin Board: ESCI), whose common stock trades on the OTCBB under the symbol ESCI.

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SOURCE Wisconsin Electric-Wisconsin Gas

CONTACT: Margaret Stanfield of Wisconsin Electric-Wisconsin Gas, +1-414-221-4444, or Natalie Wilkins of Clarus Public Relations, for ADA Environmental Solutions, LLC, +1-303-296-0343 x 239

Arch Coal Inc. Joins ADA-ES Mercury Emissions Control Effort

Energy Secretary Abraham Lauds Participation of Arch Coal

LITTLETON, COLO. – March 20, 2002 – Environmental technology and specialty chemical company ADA-ES, a subsidiary of Earth Sciences (OTCBB: ESCI), announced today that Arch Coal, Inc. (NYSE: ACI) has joined its mercury control project team and will provide significant funding to support the development of mercury control technology for coal-fired boilers.

Secretary of Energy Spencer Abraham expressed his commendation for the increased private sector participation in the project. "We are extremely pleased that one of our Nation's largest coal producing companies recognizes the value of this government-industry research program," Abraham said. "Cleaner technology is the future of America's coal industry. President Bush emphasized the importance of advanced technology in his National Energy Policy and more recently in his Clear Skies initiative. The participation of a leading coal company sends an important signal that the coal industry is prepared to commit its resources to ensuring that Americans breathe cleaner, healthier air and enjoy a more energy secure future."

In October 2000, ADA-ES began work on the nation's first full-scale program to test advanced mercury control technologies. The technologies will be used by power generating companies to comply with potential future Environmental Protection Agency regulations for mercury emissions from the nation's coal-fired power plants. In the project, ADA-ES is demonstrating the use of activated carbon to remove mercury from power plant flue gases. This work is being performed in cooperation with the U.S. Department of Energy's National Energy Technology Laboratory (DOE/NETL).

One of the largest coal producers in the U.S., Arch is committed to continuing efforts to make coal an increasingly clean resource that can be used in a manner that is highly consistent with the nation's environmental objectives. Steven F. Leer, Arch Coal's President and CEO, states: "This project reflects our commitment to finding new ways to burn coal more cleanly, while enabling the nation to make full use of its enormous reserves of coal. We are pleased to be supporting this program and are encouraged about the results obtained to date."

"We welcome Arch Coal's participation on the program team," said Michael Durham, President of ADA-ES. "Thanks to responsible organizations like Arch Coal and our other team members, including power companies and suppliers of key equipment and supplies, the carbon injection technology is rapidly advancing and will provide a reliable means for the clean use of coal. Arch

will be a valuable member of the team that brings the key perspective and knowledge base of a coal producer."

Under the DOE/NETL cooperative agreement, ADA-ES is working in partnership with PG&E National Energy Group, Wisconsin Electric, a subsidiary of Wisconsin Electric-Wisconsin Gas, Alabama Power Company, a subsidiary of Southern Company (NYSE:SO), Ontario Power Generation, TVA and EPRI. The DOE will fund $4.5 million of the $6.8 million project while the other participating companies will co-fund the remaining $2.3 million.

During the three-year project, mercury control systems will be installed and tested at four coal-fired power plants. ADA-ES has developed a mercury control system where sorbents are injected into the flue gas and collected by existing particle collection systems. The sorbents will absorb the mercury, resulting in substantial emissions reduction. According to the DOE's National Energy Technology Laboratory, which is spearheading the project, the goal is to develop a cost-effective technology that will allow the electric utility industry to reduce mercury emissions from power plants by up to 70 percent of current levels.

About ADA-ES
Headquartered in Littleton, Colo., ADA-ES is an environmental technology and specialty chemical company that brings 25 years of experience to improve responsible profitability for electric power and industrial companies through proprietary products and systems that mitigate environmental impact while reducing operating costs.

ADA-ES is a subsidiary of Earth Sciences, whose common stock trades on the OTCBB under the symbol ESCI.

About Arch Coal, Inc.
Arch Coal is the nation's second largest coal producer and mines low-sulfur coal exclusively. Through its subsidiary operations in West Virginia, Kentucky, Virginia, Wyoming, Colorado and Utah, Arch provides the fuel for approximately 6 percent of the electricity generated in the United States. One of Arch Coal's highest priorities is to operate safe and environmentally responsible mines.
Arch Coal is traded on the New York Stock Exchange under the ticker symbol ACI. The company's corporate headquarters are located in St. Louis, Missouri.

This press release may contain forward-looking information within the meaning of Section 27A of the Securities Act of 1933 and Section 21E of the Securities Exchange Act of 1934. The United States Private Securities Litigation Reform Act of 1995 provides a "safe harbor" for such forward-looking statements in this document that are based on information the Company believes reasonable, but such projections and statements involve significant uncertainties. Actual events or results could differ materially from those discussed in the forward-looking statements as a result of various factors including but not limited to changing market demand for ADA-ES chemicals and systems and changes in technology, laws or regulations, demand for the Company's securities, and other factors discussed in the Company's 1999 Form 10-KSB and recent Form 10-QSBs.

Contact Information
Michael Durham (miked@adaes.com)
ADA-ES
(303) 734-1727

Deck Slone (dslone@archcoal.com)
Arch Coal, Inc.
(314) 994-2717